In the Specification

Kindly amend Title as follows:

HIGH-STRENGTH STEEL ~~PRODUCT EXCELLING IN~~ HAVING HIGH FATIGUE STRENGTH AND ~~PROCESS~~ METHOD FOR ~~PRODUCING~~ MANUFACTURING THE SAME

Kindly amend first paragraph on Page 1 as follows:

Technical Field

~~The present invention~~ This disclosure relates to a high-strength steel having high fatigue strength that is suitable for use in automotive parts made from bar steel, such as constant velocity joints, drive shafts, crank shafts, connecting rods, and hubs, and to a method for manufacturing the high-strength steel.

Kindly amend second paragraph on Page 1 as follows:

Background ~~Art~~

Connecting rods and hubs are manufactured by hot forging or rotary forming and subsequent cutting. Constant velocity joints, drive shafts, crank shafts, and hubs are manufactured by annealing or spheroidize annealing for improved machinability, followed by hot forging or rotary forming, and subsequent partial or whole high-frequency induction quenching or nitriding. Such products require high strength and long fatigue life to achieve vehicle weight reduction.

Kindly amend paragraph spanning Pages 2 and 3 as follows:

~~Disclosure of Invention~~

~~In light of such existing circumstances, it is an objective of the present invention~~ It could therefore be advantageous to provide a high-strength steel that has a strength of 1000 MPa or more and a rotating bending fatigue strength of 550 MPa or more through the proper control of composition and structure, and an advantageous method for manufacturing the high-strength steel.

Kindly amend first paragraph on Page 3 as follows:

It ~~is another objective of the present invention~~ <u>could also be advantageous</u> to provide a high-strength steel by proper structure control of a base metal and a surface metal, in which the base metal has a strength of 1000 MPa or more and, after high-frequency induction quenching or nitriding, has a rotating bending fatigue strength of 800 MPa or more, and an advantageous method for manufacturing the high-strength steel.

Kindly amend second paragraph beginning on Page 3 through Page 5 as follows:

~~To this end, the present inventors have found the following fact through intense study.~~

~~(1) While a fine grain size of a steel results in high strength and high fatigue strength, it is not sufficient to achieve the target fatigue strength of the present invention.~~

~~(2) The composition control of the steel structure for generating not only fine ferrite, but also fine cementite effectively increases the fatigue strength. In addition, this finely dispersed cementite increases uniform elongation, thus improving the workability of the material.~~

~~(3) In addition to the composition control of the steel, working at 550-700°C under a strain of 1.0 or more is effective in preparing the steel structure containing the fine ferrite and the fine cementite.~~

~~(4) While the fine grain size of the steel results in the high strength and the high fatigue strength, it is not sufficient to achieve the target fatigue strength of the present invention, because the grain size increases during subsequent high-frequency induction quenching.~~

~~(5) When the composition is controlled to achieve the steel structure containing the fine ferrite and the fine cementite, the finely dispersed cementite and a ferrite boundary of the base metal act as nuclei in austenitizing during high-frequency heating. Thus, austenitizing occurs at many nuclei, and thereby a prior austenite grain size of the resulting martensite decreases. As a result, the strength and~~

~~the fatigue strength remarkably increase even after the high-frequency induction quenching.~~

~~(6) The effect is larger when the high-frequency induction quenching is performed at relatively low temperature.~~

~~(7) While the fine grain size of the steel results in high strength and high fatigue strength, when nitriding is subsequently applied to a surface metal, it is not sufficient to achieve the target fatigue strength of the present invention. This is because the grain size increases during the nitriding.~~

~~(8) When the composition is controlled to achieve the steel structure containing the fine ferrite and the fine cementite, the finely dispersed cementite acts as a pinning during nitriding to suppress the growth of the ferrite grain. This decreases the size of the resulting ferrite grain in the surface metal. As a result, the strength and the fatigue strength remarkably increase even after the nitriding.~~

Kindly amend first paragraph beginning on Page 5 through Page 10 as follows:

~~Best Mode for Carrying Out the Invention~~ Summary

~~Accordingly, the present invention includes the following aspects~~ We provide:

1. A high-strength steel having high fatigue strength comprising:

C: 0.3-0.8 percent by mass,

Si: 0.01-0.9 percent by mass, and

Mn: 0.01-2.0 percent by mass,

the remainder containing Fe and unavoidable impurities,

wherein the high-strength steel has a ferrite-cementite structure having a grain size of 7 μm or less, or a ferrite-cementite-pearlite structure having a grain size of 7 μm or less.

2. The high-strength steel having high fatigue strength in Paragraph 1, further comprising:

Mo: 0.05-0.6 percent by mass.

3. The high-strength steel having high fatigue strength in Paragraph 2, further comprising at least one selected from the group consisting of:

Al: 0.015-0.06 percent by mass,

Ti: 0.005-0.030 percent by mass,

Ni: 1.0 percent by mass or less,

Cr: 1.0 percent by mass or less,

V: 0.1 percent by mass or less,

Cu: 1.0 percent by mass or less,

Nb: 0.05 percent by mass or less,

Ca: 0.008 percent by mass or less, and

B: 0.004 percent by mass or less.

4. The high-strength steel having high fatigue strength in Paragraph 1, 2, or 3, wherein the percentage of the cementite structure is 4 percent by volume or more.

5. The high-strength steel having high fatigue strength in Paragraph 2, wherein a surface metal of the steel after high-frequency induction quenching has a martensite structure having a prior austenite grain size of 12 μm or less.

6. The high-strength steel having high fatigue strength in Paragraph 5, further comprising at least one selected from the group consisting of:

Al: 0.015-0.06 percent by mass,

Ti: 0.005-0.030 percent by mass,

Ni: 1.0 percent by mass or less,

Cr: 1.0 percent by mass or less,

V: 0.1 percent by mass or less,

Cu: 1.0 percent by mass or less,

Nb: 0.05 percent by mass or less,

Ca: 0.008 percent by mass or less, and

B: 0.004 percent by mass or less.

7. The high-strength steel having high fatigue strength in Paragraph 2, wherein a surface metal of the steel has a hard layer generated by nitriding and the size of a ferrite grain in the surface metal after the nitriding is 10 μm or less.

8. The high-strength steel having high fatigue strength in Paragraph 7, further comprising at least one selected from the group consisting of:

Al: 0.015-0.06 percent by mass,

Ti: 0.005-0.030 percent by mass,

Ni: 1.0 percent by mass or less,

Cr: 1.0 percent by mass or less,

V: 0.1 percent by mass or less,

Cu: 1.0 percent by mass or less,

Nb: 0.05 percent by mass or less,

Ca: 0.008 percent by mass or less, and

B: 0.004 percent by mass or less.

9. The high-strength steel having high fatigue strength in Paragraph 7 or 8, wherein the percentage of the cementite structure in a base metal of the steel is 4 percent by volume or more.

10. A method for manufacturing high-strength steel having high fatigue strength comprising:

processing a raw material containing

C: 0.3-0.8 percent by mass,

Si: 0.01-0.9 percent by mass,

Mn: 0.01-2.0 percent by mass,

Fe, and unavoidable impurities at 550-700°C under a strain of 1.0 or more.

11. The method for manufacturing high-strength steel having high fatigue strength in Paragraph 10, wherein the raw material further comprises

Mo: 0.05-0.6 percent by mass.

12. The method for manufacturing high-strength steel having high fatigue strength in Paragraph 11, wherein the raw material further comprises at least one selected from the group consisting of:

Al: 0.015-0.06 percent by mass,

Ti: 0.005-0.030 percent by mass,

Ni: 1.0 percent by mass or less,

Cr: 1.0 percent by mass or less,

V: 0.1 percent by mass or less,

Cu: 1.0 percent by mass or less,

Nb: 0.05 percent by mass or less,

Ca: 0.008 percent by mass or less, and

B: 0.004 percent by mass or less.

13. The method for manufacturing high-strength steel having high fatigue strength in Paragraph 11 comprising:

processing the raw material at 550-700°C under a strain of 1.0 or more, and then

applying high-frequency induction quenching.

14. The method for manufacturing high-strength steel having high fatigue strength in Paragraph 13, wherein the raw material further comprises at least one selected from the group consisting of:

Al: 0.015-0.06 percent by mass,

Ti: 0.005-0.030 percent by mass,

Ni: 1.0 percent by mass or less,

Cr: 1.0 percent by mass or less,

V: 0.1 percent by mass or less,

Cu: 1.0 percent by mass or less,

Nb: 0.05 percent by mass or less,

Ca: 0.008 percent by mass or less, and

B: 0.004 percent by mass or less.

15. The method for manufacturing high-strength steel having high fatigue strength in Paragraph 11 comprising:

processing the raw material at 550-700°C under a strain of 1.0 or more, and then

applying nitriding to a surface metal of the steel.

16. The method for manufacturing high-strength steel having high fatigue strength in Paragraph 15, wherein the raw material further comprises at least one selected from the group consisting of:

Al: 0.015-0.06 percent by mass,

Ti: 0.005-0.030 percent by mass,

Ni: 1.0 percent by mass or less,

Cr: 1.0 percent by mass or less,

V: 0.1 percent by mass or less,

Cu: 1.0 percent by mass or less,

Nb: 0.05 percent by mass or less,

Ca: 0.008 percent by mass or less, and

B: 0.004 percent by mass or less.

Kindly insert new paragraph before first paragraph on Page 10 as follows:

<u>Detailed Description</u>

<u>We found the following:</u>

<u>(1) While a fine grain size of a steel results in high strength and high fatigue strength, it is not sufficient to achieve the target fatigue strength.</u>

<u>(2) The composition control of the steel structure for generating not only fine ferrite, but also fine cementite effectively increases the fatigue strength. In addition, this finely dispersed cementite increases uniform elongation, thus improving the workability of the material.</u>

<u>(3) In addition to the composition control of the steel, working at 550-700°C under a strain of 1.0 or more is effective in preparing the steel structure containing the fine ferrite and the fine cementite.</u>

<u>(4) While the fine grain size of the steel results in the high strength and the high fatigue strength, it is not sufficient to achieve the target fatigue strength, because the grain size increases during subsequent high-frequency induction quenching.</u>

<u>(5) When the composition is controlled to achieve the steel structure containing the fine ferrite and the fine cementite, the finely dispersed cementite and a ferrite boundary of the base metal act as nuclei in austenitizing during high-frequency heating. Thus, austenitizing occurs at many nuclei, and</u>

thereby a prior austenite grain size of the resulting martensite decreases. As a result, the strength and the fatigue strength remarkably increase even after the high-frequency induction quenching.

(6) The effect is larger when the high-frequency induction quenching is performed at relatively low temperature.

(7) While the fine grain size of the steel results in high strength and high fatigue strength, when nitriding is subsequently applied to a surface metal, it is not sufficient to achieve the target fatigue strength of the present invention. This is because the grain size increases during the nitriding.

(8) When the composition is controlled to achieve the steel structure containing the fine ferrite and the fine cementite, the finely dispersed cementite acts as a pinning during nitriding to suppress the growth of the ferrite grain. This decreases the size of the resulting ferrite grain in the surface metal. As a result, the strength and the fatigue strength remarkably increase even after the nitriding.

Kindly amend first paragraph on Page 10 as follows:

~~The present invention~~ Our steels will be described in detail below. First ~~of all~~, ~~the reason~~ reasons that the composition of the steel ~~according to the present invention~~ is limited to the range described above will be explained.

Kindly amend second paragraph on Page 11 as follows:

In addition to the basic elements described above, other elements described below can be used ~~appropriately in the present invention~~ as desired.

Kindly amend first paragraph on Page 14 as follows:

While suitable compositions are described above, limiting the composition within the above-mentioned range is not sufficient ~~for the implementation of the present invention~~ to achieve our steels. Structure control of the steel is also required, as shown below.

Kindly amend third paragraph on Page 14 as follows:

When the structure is not a ferrite-cementite structure having a grain size of 7 μm or less or a ferrite-cementite-pearlite structure having a grain size of 7 μm or less, the target strength of 1000 MPa or more ~~of the present invention~~ will not be achieved. Thus, the ferrite grain size is limited to 7 μm or less. Preferably, the ferrite grain size is 5 μm or less.

Kindly amend second paragraph on Page 17 as follows:

When the size of a ferrite grain in a surface metal after nitriding, that is, a nitrided case is more than 10 μm, the target bending fatigue strength of 800 MPa or more ~~of the present invention~~ cannot be achieved. Thus, the size of the ferrite grain in the surface metal after nitriding is limited to 10 μm or less. Preferably, it is 5 μm or less.

Kindly amend fourth paragraph on Page 17 as follows:

The following are the conditions for manufacturing our ~~steel~~ steels ~~according to the present invention~~.

Kindly amend last paragraph on Page 25 as follows:

Industrial Applicability

~~According to the present invention, a~~ A high-strength and high-fatigue-strength steel that has a base metal strength of 1000 MPa or more and a rotating bending fatigue strength of 550 MPa or more or 800 MPa or more can be consistently manufactured.